Medical Importance of Mosquitoes

Mosquitoes are responsible for the transmission of many medically important pathogens and parasites such as viruses, bacteria, protozoans, and nematodes which cause serious diseases like malaria, dengue, yellow fever, encephalitis or filariasis (Kettle, 1995; Beaty and Marquardt, 1996; Lehane, 1991). Transmission can be mechanical (e.g. myxoma virus causing myxomatosis in rabbits) or biological. The latter is more complex because it involves an obligatory period of replication and/or development of the pathogen or parasite in the vector insect. Due to their blood-sucking behaviour, mosquitoes are able to acquire the pathogens or parasites from one vertebrate host and pass them to another, if the mosquito’s ecology and physiology is appropriate for transmission. Highly efficient vectors have to be closely associated with the hosts, and their longevity has to be sufficient to enable the pathogens/parasites to proliferate and/or to develop to the infective stages in the vector. For successful transmission, usually multiple blood-meals are necessary.

In terms of morbidity and mortality caused by vector-borne diseases, mosquitoes are the most dangerous animals confronting mankind. They threaten more than two billion people in tropical and subtropical regions, and have substantially influenced the development of mankind, not only socio-economically but also politically. Undoubtedly insect-transmitted pathogens leading to epidemics and pandemics have been instrumental in the development, decline and fall of empires e.g. in Greece and Rome. Malaria was the dominant health problem in the latter days of the Roman Empire (Bruce-Chwatt and de Zulueta, 1980). The Roman marshes were notorious for “mala aria” (bad air). This disease killed also Alexander the Great and prevented the conqueror from extending his empire, to mention but a few examples.

3.1. MALARIA

Human malaria caused by the protozoans Plasmodium spp. continues to be the most important vector-borne disease. It affects more than 100 tropical countries, placing more than 40% of the world population at risk. Some 300 million people are believed to be infected with malaria parasites, with 90% of them living in tropical Africa (WHO, 1993; WHO, 1997a,b). In Africa, the disease is probably responsible for no less than 500 000 to 1.2 million deaths annually, mainly among children below the age of five. The enormous total of lives and days of labour lost, the costs of treatment of patients, and the negative impact of the disease on development make malaria a major social and economic burden. The annual costs of malaria in Africa alone were estimated to be almost 2 billion US$ (WHO, 1993).

Four species of the genus Plasmodium (P. falciparum, P. vivax, P. ovale and P. malariae) cause human malaria and are transmitted solely...
by anopheline mosquitoes. About 20 *Plasmodium* species occur in other primates, a similar number in other mammals, and about 40 each in birds and reptiles (Garnham, 1980, 1988).

The *Plasmodium* species have a complex replication and transmission cycle with the sexual replication in mosquitoes and the asexual replication in vertebrates (Fig. 3.1). Shortly after the ingestion of blood from infected vertebrates containing sexual forms of the parasite, the gametes fuse in the mosquito gut to form a zygote which elongates and develops into a motile ookinete (Fig. 3.2A). It penetrates to the outside of the midgut epithelium, settles there and forms an oocyst (Fig. 3.2B). Meiotic and subsequent mitotic divisions (sporogony) within the oocyst

Figure 3.1. Life cycle of malaria parasites in *Anopheles* and the human host.